CNS/ATM FOR TACTICAL MILITARY AIRCRAFT

RNAV

Mode S RNP

ADS-B

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NAVAL AIR SYSTEM COMMAND

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DCS CORPORATION

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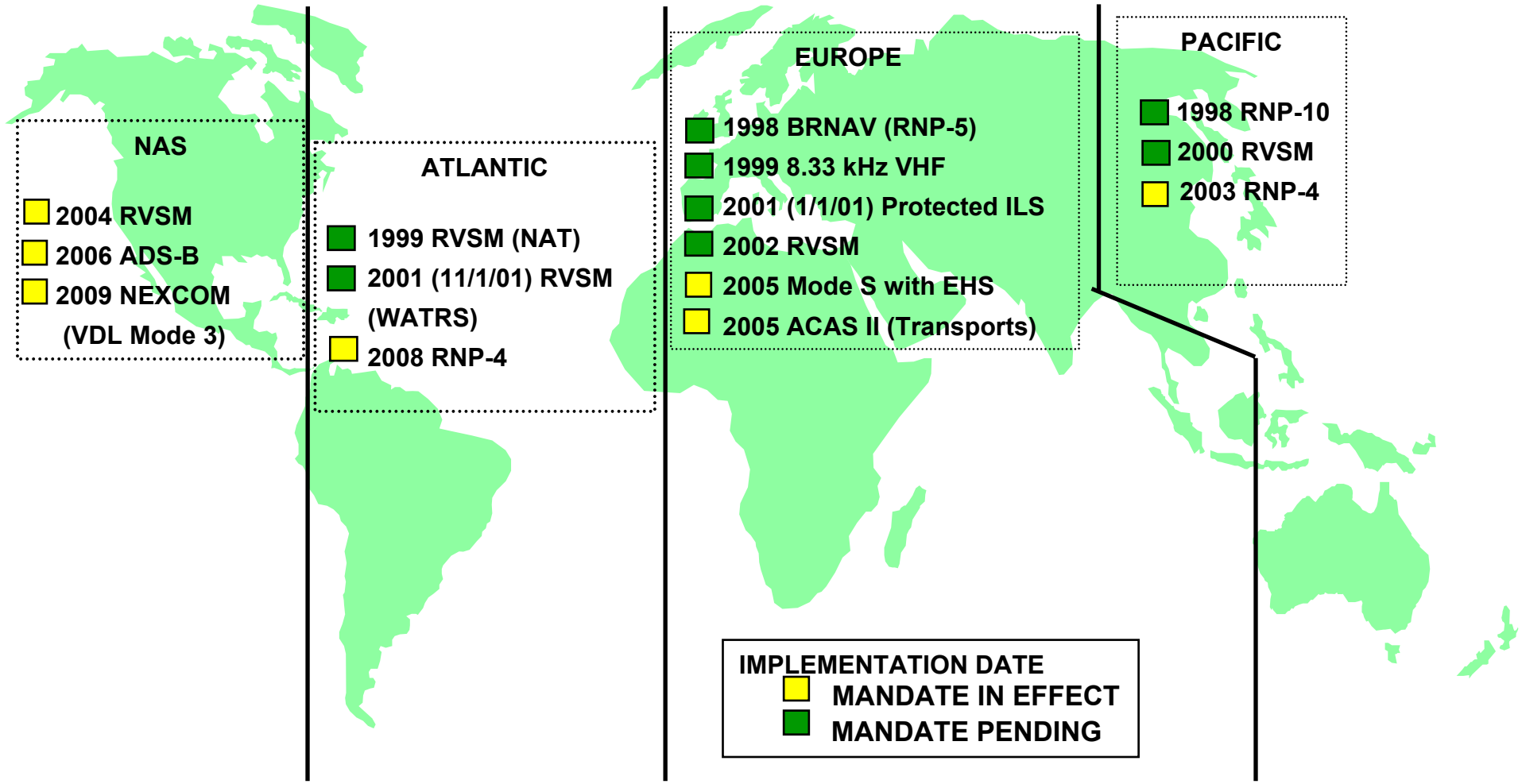
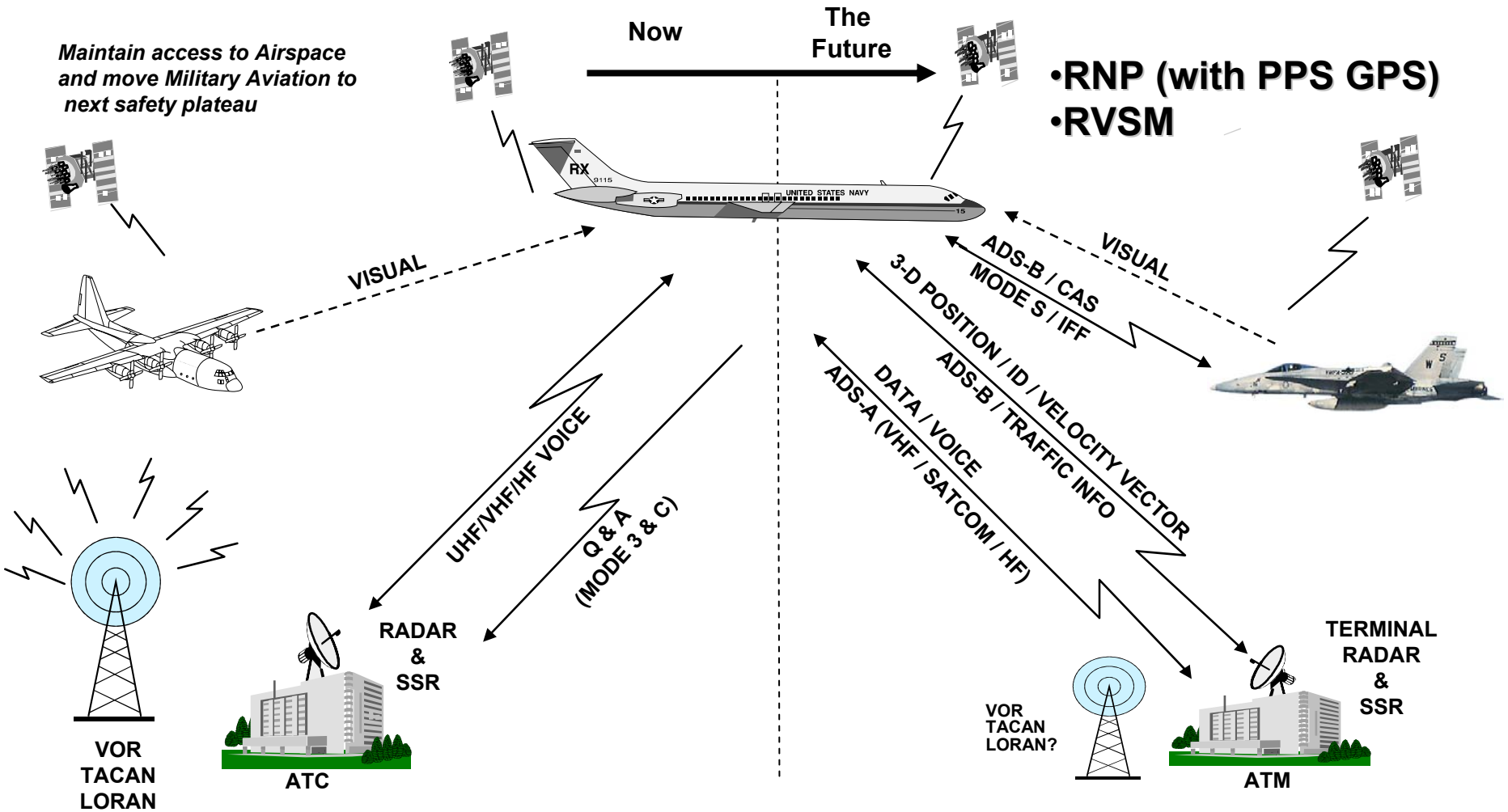
CNS/ATM REQUIREMENTS



TRANSITION To CNS/ATM



Getting Connected is the Goal

CIVIL AIRSPACE COMPLIANCE

Aircraft	BRNAV/ RNP	8.33KHz	FMI	RVSM	Mode S	TCAS
EP/P-3	R	R	Y		R	
KC/C-130T	R	G	Y		G	G
C-2A	R	G	Y		G	G
E-2C	R	R			R	
EA-6B	R	G	G	R	R	
KC-130J	R	R	G		G	G
VH-3D/60N	R		G		G	B
H-53 series	R		Y		R	
MH-60R/S	R				R	
F/A-18E/F	R	G		R	R	
MV-22B	R	G	Y		R	R
A/UH-1Z/Y	R				R	
TA/AV-8B	R	G		R	R	
F/A-18A+	R	R		R	R	
F/A-18C/D	R	Y		R	R	

B Capability Exists
G Program On Track
Y Some Aircraft Have Achieved Capability

R Unfunded Requirement.
Not Applicable for this aircraft

RNP RNAV MANDATE

- RNP RNAV Definition
  - RNAV – Fly Direct to Geodetic Fixes (Area Navigation = RNAV)
  - RNP- Required Navigation Performance in Civil Airspace

    (Example RNP-4 Airspace is 4 NM position accuracy)
- US Military Guidance

  Aircraft must "conform with civil airspace required navigation performance (RNP) requirements, prevent violation of civil air traffic clearances, and ensure safe separation of military and civil air traffic."
- Challenge
  - Cargo Aircraft employ readily available commercial solutions
  - Tactical Aircraft Are Space and Weight Limited
    - Obtain Equivalent Performance Re-Using Military Avionics

RNP RNAV REQUIREMENTS

Performance Requirement

- Lateral Accuracy +/-0.3 NM, 95%
- Integrity 10^{-5} per flight hour
- Continuity 10^{-3} per flight hour
- All Flight Phases except take off

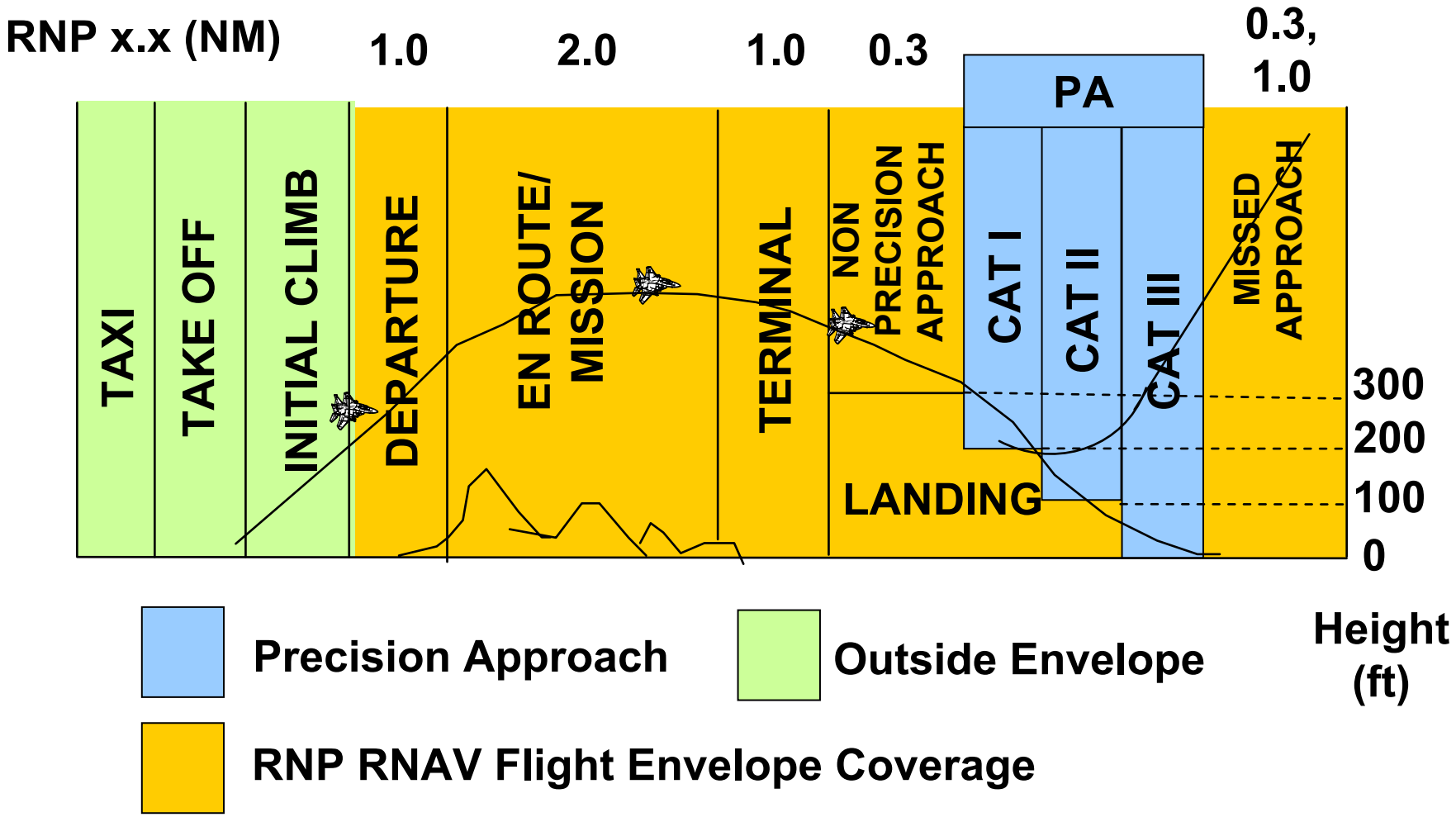
Not Required

- Along Track Error
- Vertical Navigation
- Autopilot
- Radius to Fix, Fix Altitude, Holding Legs

Navigation Requirement

- Primary Navigation Sensor Shall be the Precise Positioning Service (PPS) GPS
  - DOD Policy
  - Wide Area Augmentation not Required
    - PPS GPS Provides Ionospheric Correction via L1, L2
    - 10 Times Faster Chipping Rate than Standard Positioning Service
- Inertial Sensor Aiding to Provide Navigation Continuity During GPS Outage
- Integrity of the Navigation System GPS and INS

FLIGHT PHASES



RNP RNAV FLIGHT PHASES

Enroute

- RNP 2 Programmed
  - Manual or Flight Planning Alterable
- Track to Fix Legs Constructed
- Parallel Offsets

Terminal

- RNP 1 Programmed, not Alterable
- 10 Second Alert in Pilot Primary View
- Minimum Leg Types Supported:

  TF, IF, DF, CF

Approach

- RNP 0.3 Programmed, not Alterable
- Approach Procedure not Alterable
- Missed Approach is Similar to Departure with Automatic Entry
- Deselect Default Waypoint is Destination Airport

Departure (and Take Off)

- RNP 0.3 Programmed, not Alterable
- Manual Entry
- Revert to Terminal Accuracy (RNP 1) on Start of First Waypoint Turn

Naval Aviation CNS/ATM "Certification" Process

- Identify appropriate CNS/ATM functionalities that will apply to each T/M/S aircraft
- Write a Functional Requirements Document (FRD) that defines minimum system performance requirements for each functionality
- Obtain CNO approval of the FRD via signature and establish the requirement for specific aircraft
- The NAVAIR systems engineering team develops the capability
- The FRD minimum performance will be demonstrated
- CNO fleet introduction letter completes the "Certification" process

Certification for Naval Aviation = authorization for fleet use

CIVIL AIR SURVEILLANCE

- TCAS II in passenger carriers (Mode S)
- Mode S required in Europe by 2005
- Transition to ADS-B over next 12 years
  - CDTI required for Free Flight
- Two data links planned
  - Mode S 1090 MHz
  - UAT
- Cargo Airlines Association in the lead
  - UPS, FedEx, Airborne Express, etc

MILITARY AIR SURVEILLANCE

- Mode S for Civil Interoperability, 2005
- TCAS II in military transports by 2005
- Lots of information available on 1090 MHz
- 1090ES ADS-B available with Mode S
- Is there a military utility of Mode S?
- Evaluate the military utility of ADS-B
  - Situational Awareness, Combat Identification
- Dual use equipment desired

COMMON TRANSPONDER APX-118

- Replaces airborne, shipboard, and ground based transponders
- Digital Transponder acquired as a Non-developmental Item (NDI)
- Reliability & Maintainability (R&M) improvements
- Mode S with Enhanced Surveillance
- One Box for TACAIR:
  IFF, Mode S, 1090ES ADS-B

SUMMARY

- Civil aviation is transitioning to RNP, Mode S, and ADS-B
- Tactical military aircraft will need these functionalities
- Readily available commercial solutions will not fit in tactical military aircraft
- Tactical military aircraft can capture these functionalities with dual use avionics
- The appropriate functionality must be achieved before the aircraft is authorized to use it

BACK UP SLIDES

SSR Capability

	1030 MHz Tx	1030 MHz Rx	1090 MHz TX	1090 MHz Rx
MK XII TRANSPONDER		YES	YES	
MK XII INTERROGATOR	YES			YES
MODE S TRANSPONDER		YES	YES	
MODE S INTERROGATOR	YES			YES
ACAS II	ACAS II Box	Mode S Box	Mode S Box	ACAS II Box
1090 MHz ADS-B		YES	YES	YES
		TIS		TIS-B

GPS / RADAR / IFF